


Please check the examination details below before entering your candidate information

Candidatesurname					Other names				
<b>Pearson Edexcel International GCSE</b>									
Centre Number					Candidate Number				
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Time 2 hours					Paper reference		<b>4PM1/01</b>		
<b>Further Pure Mathematics PAPER 1</b>									
									
Calculators may be used.								Total Marks	

### Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Without sufficient working, correct answers may be awarded no marks.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- You must **NOT** write anything on the formulae page.  
Anything you write on the formulae page will gain NO credit.

### Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

### Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.
- Good luck with your examination.

Turn over ►

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## International GCSE in Further Pure Mathematics Formulae sheet

### Mensuration

Surface area of sphere =  $4\pi r^2$

Curved surface area of cone =  $\pi r \times$  slant height

Volume of sphere =  $\frac{4}{3}\pi r^3$

### Series

#### Arithmetic series

Sum to  $n$  terms,  $S_n = \frac{n}{2}[2a + (n-1)d]$

#### Geometric series

Sum to  $n$  terms,  $S_n = \frac{a(1-r^n)}{(1-r)}$

Sum to infinity,  $S_\infty = \frac{a}{1-r} \quad |r| < 1$

#### Binomial series

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \dots + \frac{n(n-1)\dots(n-r+1)}{r!}x^r + \dots \quad \text{for } |x| < 1, n \in \mathbb{Q}$$

### Calculus

#### Quotient rule (differentiation)

$$\frac{d}{dx} \left( \frac{f(x)}{g(x)} \right) = \frac{f'(x)g(x) - f(x)g'(x)}{[g(x)]^2}$$

### Trigonometry

#### Cosine rule

In triangle  $ABC$ :  $a^2 = b^2 + c^2 - 2bc \cos A$

$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

$$\sin(A+B) = \sin A \cos B + \cos A \sin B$$

$$\sin(A-B) = \sin A \cos B - \cos A \sin B$$

$$\cos(A+B) = \cos A \cos B - \sin A \sin B$$

$$\cos(A-B) = \cos A \cos B + \sin A \sin B$$

$$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$$\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

### Logarithms

$$\log_a x = \frac{\log_b x}{\log_b a}$$

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**Answer all ELEVEN questions.**

**Write your answers in the spaces provided.**

**You must write down all the stages in your working.**

- 1** The quadratic equation

$$3(k + 2)x^2 + (k + 5)x + k = 0$$

has real roots.

Find the set of possible values of  $k$ .

(6)

(Total for Question 1 is 6 marks)



2 Angle  $\alpha$  is acute such that  $\cos \alpha = \frac{3}{5}$

Angle  $\beta$  is obtuse such that  $\sin \beta = \frac{1}{2}$

(a) Find the exact value of

(i)  $\tan \alpha$

(ii)  $\tan \beta$

(3)

(b) Hence show that

$$\tan(\alpha + \beta) = \frac{m\sqrt{3} - n}{n\sqrt{3} + m}$$

where  $m$  and  $n$  are positive integers whose values are to be found.

(3)

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**Question 2 continued**

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**(Total for Question 2 is 6 marks)**





**Question 3 continued**

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**Question 3 continued**

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**(Total for Question 3 is 10 marks)**



4 The  $n$ th term of an arithmetic series is  $u_n$  where

$$u_n = (n + 1) \ln 4$$

Given that the sum of the first  $n$  terms of the series is  $S_n$

show that  $S_n = \ln 2^{(n^2 + an)}$  where  $a$  is an integer whose value is to be found.

(5)

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**Question 4 continued**

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**(Total for Question 4 is 5 marks)**



5 (a) Expand  $(1 + ax)^n$  in ascending powers of  $x$  up to and including the term in  $x^3$

Express each coefficient of  $x$  in terms of  $a$  and  $n$  where  $a$  and  $n$  are constants and  $n > 2$

(2)

The coefficient of  $x$  is 15 and the coefficient of  $x^2$  is equal to the coefficient of  $x^3$

(b) Find the value of  $a$  and the value of  $n$ .

(6)

(c) Find the coefficient of  $x^3$

(2)

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**Question 5 continued**

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**(Total for Question 5 is 10 marks)**



6 (a) Show that  $(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$  (3)

The quadratic equation  $x^2 - 7kx + k^2 = 0$ , where  $k$  is a positive constant, has roots  $\alpha$  and  $\beta$  where  $\alpha > \beta$

(b) Show that  $\alpha - \beta = 3k\sqrt{5}$  (3)

(c) Hence form a quadratic equation with roots  $\alpha + 1$  and  $\beta - 1$

Give your equation in the form  $x^2 + px + q = 0$  where  $p$  and  $q$  should be given in terms of  $k$ .

(4)

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**Question 6 continued**

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**Question 6 continued**

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**(Total for Question 6 is 10 marks)**





**Question 7 continued**

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**Question 7 continued**

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**(Total for Question 7 is 11 marks)**



8 Given that  $n$  satisfies the equation

$$\log_a n = \log_a 3 + \log_a (2n - 1)$$

(a) find the value of  $n$ .

(3)

Given that  $\log_p x = 3$  and  $\log_p y - 3 \log_p 2 = 4$

(b) (i) express  $x$  in terms of  $p$ ,

(1)

(ii) express  $xy$  in terms of  $p$ .

(4)

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**Question 8 continued**

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**Question 8 continued**

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**(Total for Question 8 is 8 marks)**



9 Find an equation of the normal to the curve with equation

$$y = (x^3 - 2x)e^{(1-x)}$$

at the point on the curve with coordinates  $(1, -1)$

(5)

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**Question 9 continued**

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**(Total for Question 9 is 5 marks)**





**Question 10 continued**

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**Question 10 continued**

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**(Total for Question 10 is 14 marks)**



11 (a) Using a formula from page 2, show that  $\cos 2x = 1 - 2 \sin^2 x$  (3)

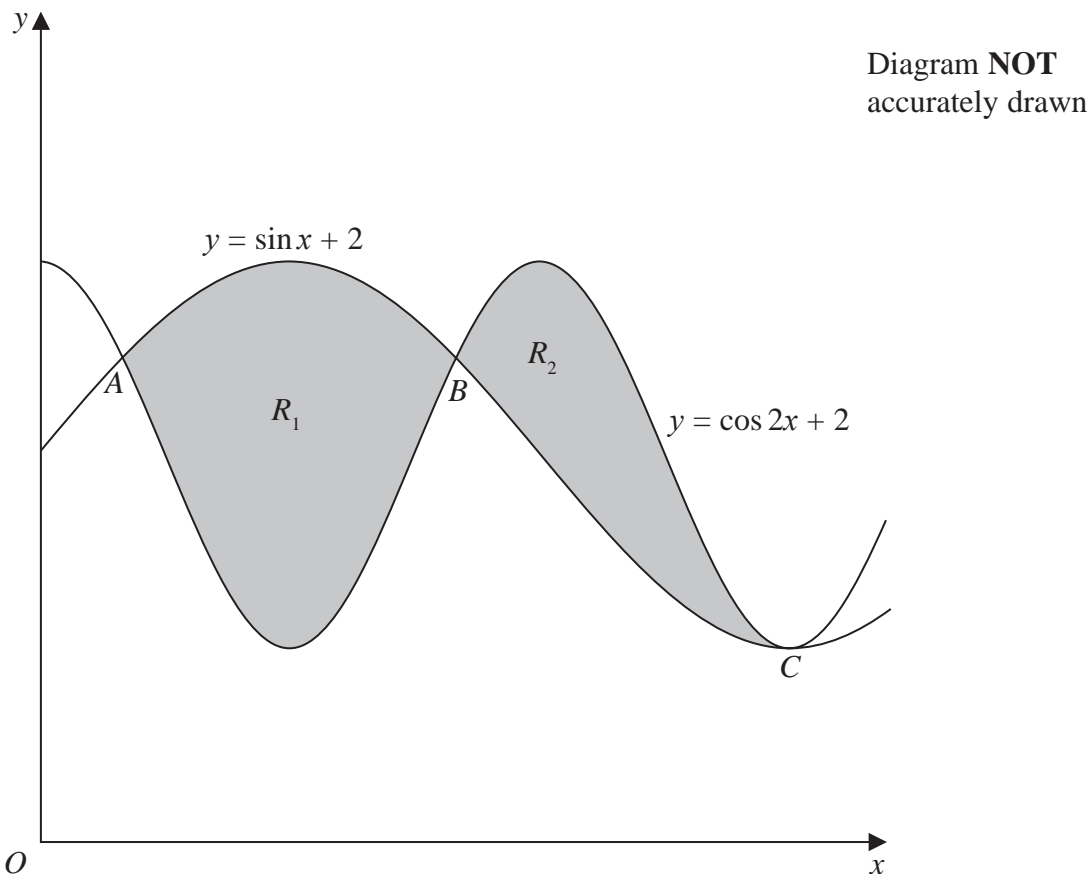


Figure 2

Figure 2 shows a sketch of part of the curves with equations  $y = \sin x + 2$  and  $y = \cos 2x + 2$

The points  $A$ ,  $B$  and  $C$ , shown in Figure 2, are three points that are common to both curves.

(b) Find the coordinates of each of these points. (4)

$R_1$  and  $R_2$ , shown shaded in Figure 2, are two regions enclosed by the two curves.

(c) Use calculus to find, in its simplest form, the ratio (8)

area of  $R_1$  : area of  $R_2$

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**Question 11 continued**

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**Question 11 continued**

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